Specification:

This invention relates to a method for producing stip-like pre-material from metal using rollers of a roll stand which define a roll gap by rolling the metal strip in two or more than two rolling steps. ~~The invention relates to a method having the features defined in the preamble of Claim 1.~~ A method of this kind has been known from DE 195 04 711 C2. In practical operation, a metal strip is repeatedly rolled, running continuously from its beginning to its end through a roll stand, the working direction of which is then reversed so that thereafter the metal strip is run through the roll stand once again over its full length, but now in reverse direction.

From DE-PS 104 875 it has been known to profile strip-shaped or plate-shaped workpieces by a single-step rolling process, for the production of tubes. A similar method is disclosed by DE 197 04 300 A1 for the production of profiled blanks, especially of car body sheets.

A reciprocating rolling method for the production of thin strips from a thick starting material is described in DE-PS 638 195. In the case of this method, the starting material is shaped step by step with a high degree of deformation, being passed through the roll gap in reverse direction to the usual rolling direction.

From US 1,106,172 ~~1.106.172~~ it has been known to convert a strip-like material continuously to profiles using an arrangement of three roll stands arranged one behind the other.

The value of coins and medals for collectors rises with their surface quality. The stamping of coins and medals starts out from proofs, i.e. coin blanks and medal blanks, which already have a high-polish surface. Proofs are stamped from a strip-like pre-material. The strip-like pre-material is produced from a pre-material of a few mm, for example 10 mm, thickness. This material is rolled in several passes to a trip of, for example, 0.5 mm to 2 mm thickness. Such a strip, the thickness of which is determined by the coins and medals to be stamped, is used as pre-material from which the proofs are stamped. Conventionally, the two rollers are exchanged before the last pass against a pair of rollers with high-mirror finish surfaces. The high-mirror finish may be achieved by lapping.

The surface quality of the two rollers diminishes with each revolution of the rollers because a certain abrasion of metal occurs during each rolling process, whereby the surface of the rollers is contaminated. The mirror finish of the roller surface is intact only during the first revolution of the rollers. Thereafter, the surface quality diminishes from one revolution to the next, and with it the surface quality of the rolled pre-material. After a strip length of approximately 100 to 1,000 coin diameters has been worked, the rollers are usually dismantled and lapped to restore their high-mirror finish. In spite of this expensive procedure, the proofs obtained do not have a uniform, high surface quality.

Now, it is the object of the present invention to provide a way of producing a strip-like pre-material economically and with a uniform, high surface quality.

~~This object is achieved by a method having the features defined in Claim 1, and by a device having the features defined in Claim 63. Advantageous further improvements of the invention are the subject-matter of the dependant claims.~~

This object is achieved in accordance with the teachings of the invention following hereinafter.

In order to permit at least two rolling steps to be carried out on one section of the metal strip with the method according to the invention, the circumference of the rollers should be equal to at least twice the length of the recalled section, and the recalled section should be a little longer than the diameter of the proofs, in order to allow for the unavoidable stamping waste. If the metal strip is rolled not only in one direction, but alternately in the one and the other direction, ~~as described in Claim 2,~~ then one may choose ~~chose~~ to roll the metal strip several times between the same segments of the two rollers and to perform the last rolling step between two circumferential segments of the rollers which had been previously employed for a smaller number of rolling steps and which, therefore, still have a better surface quality so that they will give the metal strip a surface with equally optimum quality in the last rolling step.

If sections of the metal strip are rolled alternately in one and the other direction, one additionally achieves a more ~~favourable~~ favorable material structure than would be obtained if the metal strip were rolled always in one and the same direction. This is even more important the more the thickness of the metal strip is reduced by the rolling process, because in the latter case material crowding caused by the rollers is also increased. Another advantage lies in the fact that the ~~favourable~~ favorable effect on the material structure, when rolling individual sections by a reciprocating process, is greater than when conventionally rolling a metal strip alternately in the one and the other direction over its full length.

Preferably, the roller diameter is selected so that at least ten, preferably at least fifteen proofs can be stamped from a section of the pre-material the length of which corresponds to the diameter of the rollers.

Step-by-step repeated rolling of the respective section of the metal strip is, preferably, carried out in such a way that of the surface segments of the two

with high accuracy to gauge, cannot be achieved with the known operating method.

In contrast, the present invention discloses a way of producing a profiled strip-like pre-material, for example for pens, with higher accuracy, i.e., with less deviation of the actual thickness profile from the intended thickness profile.

~~This is rendered possible by an improvement of the method according of the invention having the features defined in Claim 12, and a device having the features defined in Claim 44.~~

According to the invention, the metal strip is rolled in two or more rolling passes until the desired profile depth of the pre-material is obtained so that the entire deformation is reached by two or more reductions per pass, instead of one reduction per pass. However, this is not achieved by having the metal strip run through several roll stands arranged one behind the other; this would be by far too expensive, and the accuracy of positioning the metal strip longitudinally in the roll gap, which is required when a plurality of rolling steps are to be carried out on one and the same section of the metal strip, would be achieved either not at all or only with difficulty. Instead, the metal strip is recalled between every two successive rolling passes, and the recalled section of the metal strip is rolled once again between the same two rollers. Only when the desired profile has been achieved in a section of the metal strip to be profiled, by one or more rolling passes and after one or more recalling steps, is the next strip section fed into the roll gap for profiling that next section of the metal strip.

However, it would likewise be possible to proceed in such a way that following the first rolling pass on a first strip section a similar first rolling pass

versatility of the roll stand in the production of strips that are profiled by sections.

If two cylindrical rollers are employed, it is of advantage if one of the rollers, especially the upper roller, is provided with a notch parallel to its axis, in order to have a reference for the angular position of the roller.

In connection with the recalling step for the metal strip, the recalling device, for example the first coiler from which the metal strip is unwound, is of particular importance because it must be capable of reproducing with sufficient accuracy the length of the step by which the metal strip is recalled. To this end, the first coiler is, preferably, provided with a servomotor comprising an incremental rotary transducer which allows the desired step length to be precisely defined, both for the unwinding and for the coiling process.

The width of the metal strip may be selected to permit a single profiled part, for example a single profiled writing pen, to be punched out from each of the successively arranged strip sections. The economy of the process, and of the roll stand working according to the invention, can easily be multiplied if broader strips are profiled, which are wide enough to permit two or more writing pens or similarly profiled objects, lying one beside the other, to be formed from each profiled section of the pre-material.

~~A particularly advantageous improvement of the invention is defined in Claim 21.~~

According to ~~that~~ another improvement of the invention, the metal strip is equalised before the profile is rolled. The term equalising is understood to mean that the metal strip is rolled in a roll stand with highly constant roll gap, whereby any variations in thickness of the metal strip are reduced. Roll stands for equalising are known from DE 25 41 402 C2, to which reference is made for

further details. In the case of a known equalising roll stand a highly constant roll gap is achieved by the fact that pre-stress forces, acting vertically to the roller axes in a sense away from the material being rolled, are exerted on the roll necks, that extend outwardly beyond the roll neck bearings, which pre-stress forces may be oriented perpendicularly and may, preferably, act along a line of action that passes through the incoming metal strip and deviates from the plane of the roller axis by the rolling angle. This reduces the working play of the rollers in the roll neck bearings.

According to the invention it is, however, not intended to have the roll stand, which serves to profile the metal strip, preceded by an additional roll stand serving the equalisation process. Rather, the equalising and the profiling processes are carried out in one and the same roll stand, for which purpose the metal strip is moved through the roll gap in forward direction not only during the working steps that serve the profiling operation. Instead, the metal strip is first equalised by steps, being at least as long as the step for the profiling operation, with an only moderate reduction in thickness. Thereafter, the strip is recalled by a step of a length at least equal to the length required for the profiling operation and maximally equal to the length by which it has been advanced during the equalisation process, whereafter the profile is rolled into the recalled section of the metal strip. In a roll stand comprising a first cylindrical roller and a second profiled roller, where one circumferential segment has the contour adapted to the desired variation in thickness of, for example, a writing pen to be produced from the metal strip, the second roller is additionally provided for this purpose with a cylindrical circumferential segment separated from the circumferential segment that is provided with the contour ~~(Claim 26)~~. The cylindrical circumferential segment serves to carry out the equalising step. The length of the cylindrical circumferential segment is selected, depending on its function and giving due consideration to the elongation of the metal strip occurring during the rolling process, to ensure

that the equalised section of the metal strip will at least have the length of the writing pen, or preferably a somewhat greater length, so that the beginning and/or the end of the profiling step can occur at a certain distance from the beginning and the end of the equalised section.

Consequently, according to the invention, the roll stand serving the profiling operation is simultaneously designed as equalising roll stand and is equipped with a strip feeding system by which the strip is moved by steps in forward and backward direction.

The improvement of the invention ~~defined in Claim 21 and Claim 26~~ involving equalising in the first step offers essential advantages:

The variations in thickness of ± 20 µm in the pre-material and, thus, in the writing pens to be produced can be reduced to less than ± 2 µm in a particular pen, especially in the area of the pen that later serves as shank. A practically delivered device produced pens with variations in thickness of ± 1 µm.

The reproducibility of the thickness profile from one pen to the next initially reached ± 4 µm. With the practically delivered device it was even possible to achieve a reproducibility of ± 2 µm.

These are accuracy values that could not be reached heretofore in the production of pens by rolling. Corresponding accuracy values can be reached also with strip-like pre-materials for other profiled products than pens.

The great progress in accuracy is achieved with a minimum of apparatus input. Starting out from a roll stand known per se the profiling roll of the latter must be modified insofar as it must be provided with a suitable cylindrical segment, and the roll necks of the two rollers must be pre-stressed with a view to reducing the bearing play, for example in one of the